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FOREST HEALTH PROTECTION EVALUATION OF THE GYPSY MOTH ON THE DEERFIELD, DRY RIVER, GLENWOOD-PEDLAR, JAMES RIVER, LEE, AND WARM SPRINGS RANGER DISTRICTS OF THE GEORGE WASHINGTON AND JEFFERSON NATIONAL FORESTS, FISCAL YEAR 2002

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Abstract

In 2001, 441,044 acres were defoliated by gypsy moth in Virginia. Of this total, 322,065 acres of forested land was on the George Washington and Jefferson National Forests (GWJNF) in Virginia and West Virginia. Severe defoliation occurred on 63,664, 44,997, 77,606, and 131,503 acres of forested land on the Glenwood-Pedlar, James River, Lee, and Warm Springs Ranger Districts respectively.

During August and September, Forest Health Protection (FHP) conducted gypsy moth egg mass surveys on the Deerfield, Dry River, Glenwood-Pedlar, James River, Lee, and Warm Springs Ranger Districts of the GWJNF to determine which areas may be at risk of defoliation and damage in FY 2002. Survey results indicate that Story Book Trail, Massanutten Visitor's Center, Elizabeth Furnace, Trout Pond, and Bolar Mountain area at Lake Moomaw recreation area are above the 250/acre egg mass density threshold for nuisance and damage. Also, Fore Mountain, Chestnut Mountain, and Wildcat Mountain high-value timber areas are above the 1,000 egg mass/acre damage threshold and may be severely defoliated and damaged in 2002.

FHP recommends that the GWJNF consider taking action to manage gypsy moth populations in the above mentioned recreation and high-value timber areas to limit nuisance to campground visitors and damage to campground trees and to limit defoliation and damage in high-value stands of timber. FHP recommends that approximately 4,889 acres be aerially treated with insecticides in 2002; this acreage includes approximately 1,145 acres of developed recreation areas and 3,744 acres of high-value timber areas. The GWJNF should consider treatment using the following insecticides: (1) the biological insecticide, Bacillus thuringiensis var kurstaki, (2) the chemical insecticide, diflubenzuron, and (3) the gypsy moth-specific virus insecticide, Gypchek.

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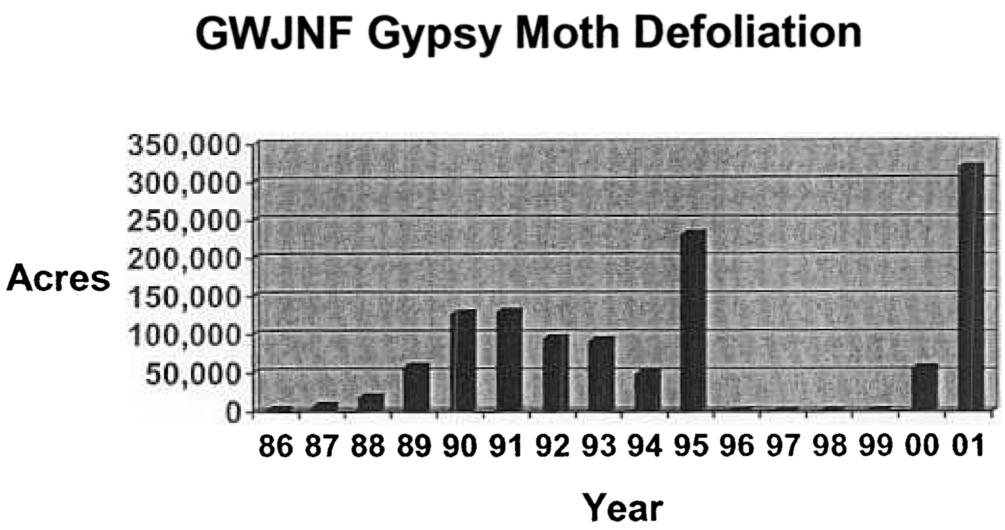
Introduction

The gypsy moth, Lymantria dispar (L.), is an exotic defoliator of North American hardwood trees. It was first introduced into Massachusetts from Europe in 1869 by Leopold Trouvelot, a French naturalist, who attempted to develop a silk industry based on hybrid crosses between the gypsy moth and native species of North American silkworms. The gypsy moth escaped from Trouvelot's laboratory and became established in a new environment of New England hardwood forests. Currently, the gypsy moth is found in deciduous forest areas throughout the northeastern United States and Canada. The generally infested, or quarantined area, extends from New England, south into North Carolina, west to Ohio, and includes the lower peninsula of Michigan. Over the past 10 years, isolated infestations have been detected and eradicated in Arkansas, Colorado, Georgia, North Carolina, Oregon, Tennessee, Utah, and other states.

The gypsy moth first caused noticeable defoliation on the George Washington and Jefferson National Forests in 1986 (Witcosky and others 1994). Over the next four years, defoliation increased as the insect spread southward across the Lee and Dry River Ranger Districts. Defoliation peaked on the Lee RD in 1990 and on the Dry River RD in 1991. Defoliation began to appear on the Pedlar portion of the Glenwood-Pedlar RD in 1990 and reached a peak in 1992. Gypsy moth populations collapsed on the Lee in 1991 and on the Dry River and Pedlar in 1992 but began to increase again on the Lee RD again in 1992. Defoliation reached an all-time high in 1995 as the southern half of the Dry River, the northern half of the Deerfield, and the midsection of the Pedlar were defoliated for the first time. Populations of gypsy moth collapsed for the second time over the entire GWJNF in 1995 and remained at very low levels across the forests from 1996 – 1999. In 2000, gypsy moth populations were rebounding in areas that had not seen defoliation since 1995. Populations continued to increase in 2001 with approximately 322,605 acres of defoliation with the heaviest defoliation on the Lee, James River, Glenwood-Pedlar, and Warm Springs Ranger Districts.



The collapse of gypsy moth populations on the Lee RD in 1991 was caused by the gypsy moth nucleopolyhedrosis virus (gmNPV). Up to this point in time, the gmNPV was the most important natural control agent for damaging levels of gypsy moth.

In 1991 and again in 1992, Forest Health Protection introduced the gypsy moth fungus, Entomophaga maimaiga Humber, Shimazu, & Soper, into a number of forest stands at the leading edge of gypsy moth spread on the Deerfield, Dry River, and Glenwood-Pedlar Ranger Districts (Hajek and others 1996). The fungus, which is pathogenic to the gypsy moth, is native to Japan and eastern Asia. E. maimaiga appeared in the northeastern United States for the first time in 1989 (Andreadis and Weseloh 1990, Hajek and others 1990), and spread throughout the range of gypsy moth in the following three years.

In 1991 and 1992, soil containing the resting spores of the gypsy moth fungus, E. maimaiga, was released at fourteen sites on the GWJNF in an attempt to introduce the fungus into this area (Hajek and others 1996). The release proved successful and the gypsy moth fungus became established at all of the release sites on the forests. In May and June 1992, E. maimaiga spread rapidly across the GWJNF, caused a major epizootic, and brought about a dramatic collapse of gypsy moth populations. Populations of gypsy moth rebounded during the drought years of 1994 and defoliated more than 230,000 acres in 1995, but collapsed that same year from the second area-wide epizootic of E. maimaiga (Witcosky 1995). Over the years of 1996 through 1999, the gypsy moth remained at very low densities across the GWJNF and caused no significant defoliation. However a drought starting in 1998 and extending into 2000 kept E. maimaiga inactive and lead to a resurgence of gypsy moth on the forests in 2000. In 2000, 55,495 acres of the George Washington and Jefferson National Forests (GWJNF) were defoliated by gypsy moth, with 32,232 and 23,263 acres defoliated in Virginia and West Virginia, respectively. Severe defoliation occurred on 2,768, 3,828, 40,042, and 8,857 acres of forested land on the Glenwood-Pedlar, James River, Lee, and Warm Springs, respectively. In 2001, the GWJNF suffered the worst defoliation on record with 322,605 acres of the George Washington and Jefferson National Forests (GWJNF) defoliated by gypsy moth in Virginia and West Virginia. In the year of the worst defoliation for the GWJNF, there was wide-spread population collapses. A combination of factors is believed to be responsible for a collapse of populations in the same year of the most severe defoliation on record. Most of the defoliated areas surveyed had scattered, small egg masses, indicating populations had been stressed and collapsed probably due to the gypsy moth nucleopolyhedrosis virus (gmNPV.) A late, wet spring enhanced the survival of the fungus E. maimaiga and is believed to have contributed to the collapse of populations.

Technical Information

Life Cycle

The gypsy moth completes a single generation each year. First instar larvae (caterpillars) emerge from egg masses in April or early May. The newly hatched larvae are about two millimeters in length and are covered with long hairs. During cold weather conditions (below 40°F or 4°C), larvae remain on or near the egg masses. As temperatures increase, the caterpillars leave the egg masses during daylight hours and climb into the forest canopy. Upon reaching the tips of branches, larvae may spin down on silken threads and disperse on the wind. Most larvae are dispersed within the local area, but some may carried for distances greater than twelve miles (Taylor and Reling 1986). Larvae may repeat this dispersal process several times before settling down to feed.

Male caterpillars usually pass through five larval instars (or, growth stages) and females pass through six. Each instar lasts four to ten days, depending on the environmental conditions prevailing during each particular stage of development. Over the first three instars, larvae alternate between feeding and resting on the foliage in the forest canopy. After molting to the fourth instar, caterpillars change behavior, feed at night, and move down from the canopy at dawn to rest in protected sites during the day. At dusk, the larvae return to the canopy again to feed. Larvae usually complete their development by early to mid-June and seek a sheltered location for pupation. The pupal stage lasts about 2 weeks. Pupae can be found at the base of branches, in bark fissures, attached to the bark surface, or in protected areas on the ground.

The male moth is dark brown and bears several black bands across the front wings and are capable fliers. The female moth is nearly white, with black bands across the front wings. Females cannot fly but they can walk short distances from their site of pupation. Females release a potent sex attractant (pheromone) to allure male moths for mating. Once mated, the female deposits her brood in a single mass of eggs and dies. The mass of eggs is covered with a layer of hairs sloughed from the female's abdomen. The egg mass, which may contain from 75 to 1,000 eggs, is buff-colored when first deposited, but may fade to a whitish color during the winter when exposed to direct sunlight and weathering. Within four to six weeks, embryos develop into larvae within the eggs, overwinter, and hatch the following spring.

The gypsy moth spreads over relatively short distances by the ballooning of first instar caterpillars on wind currents. The insect also may spread over much greater distances via human transport. Long distance spread occurs by two mechanisms, the transport of caterpillars or the transport of egg masses. People may pick up larvae in infested areas and carry them on their vehicles, belongings, or clothing to uninfested forested areas. The transport of the gypsy moth via egg masses occurs when vehicles, equipment, or household belongings infested with egg masses are brought into an uninfested areas in spring as the caterpillars are hatching.

Hosts

Gypsy moth larvae feed on more than 500 species of trees, shrubs, and vines. Favored hosts include oak, apple, birch, basswood, witch hazel, and willow. Hosts moderately favored by gypsy moth include maple, hickory, beech, black cherry, elm, and sassafras. Least favored hosts include ash, yellow poplar, American sycamore, hemlock, pine, spruce, black gum, and black locust. Late instar larvae can feed upon tree species that younger larvae avoid, such as hemlock, maple, pine, and spruce. Feeding on less favored host plants usually occurs when high density larval populations defoliate the favored tree species and move to adjacent, less favored species of trees to finish their feeding and development.

Damage

An individual gypsy moth caterpillar consumes the equivalent of approximately one square meter (10.75 square feet) of foliage during its development. A typical upland oak forest has 2.5 - 4.5 square meters of foliage per square meter of ground surface area. Thus, the feeding of a relatively few, healthy caterpillars can result in severe defoliation of oak a stand.

Defoliation by the gypsy moth may reduce tree vigor, reduce growth of shoots and stem, cause dieback of the crown, trigger a failure of hard mast production, and sufficiently weaken a tree such that it is attacked and killed by woodboring insects and root decay fungi. Hardwoods in a vigorous condition often can tolerate a year or two of defoliation before canopy dieback becomes pronounced. However, hardwoods that are stressed by drought, oak decline, or some other factor tolerate defoliation less well. The damage caused by gypsy moth feeding in spring is harmful because trees must draw upon reserve carbohydrates and nutrients to produce a second canopy of leaves following defoliation (a process referred to as refoliation). Generally, a tree refoliates when approximately 60 percent of its canopy is consumed. Production of a new set of leaves following defoliation restores the photosynthetic capability of a tree's canopy, however, the refoliation process draws upon nutrient reserves that would be used for shoot growth and foliage production the following spring. The refoliated canopy is not able to fully replace the nutrients and stored reserves mobilized by the tree during refoliation, leaving the tree in a weaker condition the following spring. As a result, trees exposed to repeated defoliation and refoliation are weaker and more susceptible to attack by wood-boring insects and root-decay fungi.

Population Dynamics

Gypsy moth population densities fluctuate widely from year to year resulting in episodes of dramatic and severe defoliation followed by periods of relative innocuousness. At low densities, the gypsy moth is regulated, but not eliminated, by natural enemies such as parasitic insects and predaceous vertebrates, particularly small mammals. As populations increase beyond the control of these natural enemies, the gypsy moth is regulated by different mortality factors, primarily diseases and starvation. Of these two factors, diseases caused by the nucleopolyhedrosis virus (gmNPV) and the gypsy moth fungus (E. maimaiga) lead to the collapse of outbreak populations of gypsy moth.

The gmNPV is an important biological control agent of gypsy moth when populations reach damaging levels. The virus was unwittingly introduced into North American gypsy moth populations in the early 1900s when USDA scientists released wasp parasitoids of the gypsy moth collected from woodlands in Europe. The wasp parasitoids were contaminated with particles of gmNPV and spread the virus to gypsy moth populations in the New England area following their release. The gmNPV is found throughout the forest environment in North America where gypsy moth populations are established and reproducing.

First instar caterpillars often ingest virus polyhedra from the contaminated shell surface or bark surface upon which the eggs were laid as they chew through their eggshells. These virus-infected early instar caterpillars succumb to infection by gmNPV after a period of incubation (approximately 10 days). This increase in early instar caterpillar mortality caused by the virus is commonly referred to as the first wave of a gmNPV epizootic (a disease epidemic in animals). Virus-infected early instar caterpillars die in the canopy and contaminate the surface of foliage with virus polyhedra as their bodies disintegrate. Next, uninfected caterpillars feed on the virus-contaminated foliage, ingest polyhedra, and become infected. After another incubation period (approximately 10 - 14 days) a second wave of virus-killed caterpillars appears as these later instar larvae succumb to the gmNPV they ingested from their siblings. It is this second wave of mortality that results in the dramatic reduction (collapse) of gypsy moth populations. The virus epizootic reaches its peak late during caterpillar development, usually as caterpillars enter the fifth and sixth instars. As a result, the collapse usually develops only after severe defoliation has occurred. Late instar caterpillars killed by gmNPV typically assume an inverted v-shape along the boles and branches of infested trees. Their bodies disintegrate and leak a brown fluid containing large numbers of virus polyhedra. These polyhedra contaminate the bark surface and contribute to infection of subsequent generations of gypsy moth.

The gypsy moth fungus, E. maimaiga, is a relatively new natural enemy of gypsy moth in North America. It first appeared on this continent in 1989 and spread rapidly throughout the northeastern United States where the gypsy moth occurs (Andreadis and Weseloh 1990; Hajek and others 1990). The fungus has caused two major epizootics in gypsy moth populations on the George Washington and Jefferson National Forests (GWJNF) since it was intentionally introduced in 1991 and 1992 (Hajek and others 1996). Development of a fungal epizootic is favored by cool, wet conditions during the spring months of April, May, and June when the caterpillars are present. Although all instars are susceptible, the third and fourth instars appear most vulnerable. The first evidence that an epizootic of the gypsy moth fungus is underway is when caterpillars appear in a head-down, stretched-out posture along the boles of infested trees. Once infected gypsy moth caterpillars are killed, the gypsy moth fungus grows out through the cuticle of the insect and produces more conidia, those spores that actually infect the caterpillar. These conidia spread and infect more caterpillars. This infection cycle may take place seven to nine times during the development of a generation of gypsy moth caterpillars under favorable environmental conditions. As caterpillar development draws to a close, the gypsy moth fungus switches from producing conidia to producing resting spores, or azygospores. The resting spores are adapted to persist in the forest environment during periods when the host caterpillars are not present and then germinate and produce conidia when a future generation of caterpillars in present.

The gypsy moth fungus causes mortality across a broad range of gypsy moth densities, even in low-density populations that do not cause noticeable defoliation. Because epizootics of E. maimaiga often develop early during larval development and then intensify progressively during the third through sixth instars, damaging populations of gypsy moth may collapse before they are able to cause severe defoliation. This contrasts with gmNPV where damaging populations of gypsy moth usually defoliate trees before they collapse due to the virus epizootic. It is evident that E. maimaiga will fundamentally alter the dynamics of gypsy moth populations in eastern and midwestern oak forests where this insect becomes established.

The gypsy moth fungus is favored by cool, wet conditions during April, May and June, the interval of time when host caterpillars are present. Epizootics of the fungus develop to their fullest extent when these cool, moist conditions prevail. However, during a spring drought or an extended drought (such as the 1994 – 1995 and the 1998 – 2000 droughts), the gypsy moth fungus resting-spores remain dormant. These drought episodes thus favor the gypsy moth by keeping E. maimaiga inactive. This allows gypsy moth populations to rebound quickly, because caterpillar survival is greatly enhanced.

The gypsy moth does not exhibit regular population cycles. Instead, this insect undergoes recurring episodic outbreaks. At the forest stand level, the period between outbreaks may range from 2 to 5 years and the actual outbreak period may range from 1 to 3 years. On a region-wide basis, gypsy moth populations develop to outbreak levels across wide areas of the northeast, mid-Atlantic, and Lake States for a period of years and then drop to very low levels for several years. Factors regulating these regional outbreaks and collapses of gypsy moth populations are not well understood.

Survey Methods and Treatment

Defoliation Surveys

Defoliation surveys were conducted from the air during June by the Virginia Department of Forestry and the West Virginia Department of Agriculture. Sketch map results were digitized and provided to FHP in digital format. FHP used GIS ownership coverage for the GWJNF to overlay with the defoliation data to estimate acreage defoliated. GWJNF district staff conducted a ground survey for defoliation of recreation areas in June.

Egg Mass Surveys

Egg mass density and egg mass length data were used to predict whether gypsy moth defoliation would likely occur in surveyed forest stands in 2002. The sampling method used in these surveys was the 1/40-acre fixed plot (Wilson and Fontaine 1978). This method was used at all recreation areas and general forest sites. A fixed number of plots were taken in developed recreation areas (1, 5, or 10 depending on the size of the site) and a minimum of 10 plots was taken in high-value timber areas.

For recreation areas, the nuisance threshold – the limit of visitor tolerance for the presence of caterpillars, their droppings, and the loss of shade – is set at densities approaching or exceeding 250 egg masses per acre. For high-value timber areas the damage threshold – where defoliation may be severe enough to stimulate trees to refoliate – is set at densities approaching or exceeding 1,000 egg masses per acre.

Egg mass length provides a measure of population vigor. Average egg mass length in excess of 25 mm suggests a high vigor gypsy moth population, while a length approaching 20 mm or less suggests a low vigor gypsy moth population. Low vigor gypsy moth populations often collapse due to virus disease once caterpillars hatch in spring.

Results and Discussion

2001 Post-Suppression Results:

Cave Mountain Lake on the Glenwood-Pedlar RD and Hidden Valley on the Warm Springs RD reached the nuisance threshold for gypsy moth in 2000 and were treated with Bacillus thuringiensis var. kurstaki (Btk) in 2001. Trout Pond and Wolf Gap, two recreation areas on the Lee RD, also reached high egg mass densities in 2000 and were treated with Bacillus thuringiensis var. kurstaki (Btk) and Dimilin respectively. These two areas have been treated with insecticides in the past to manage gypsy moth populations. Trout Pond was treated in 1988, 1990, 1992, 1994 and 2001 with Bacillus thuringiensis var. kurstaki (Btk) and Wolf Gap was treated in 1989 (diflubenzuron), 1991 (Btk), 1993 (Btk), 1994 (diflubenzuron) and 2001 (Btk).

High-value timber areas were surveyed on the Deerfield, Glenwood-Pedlar, James River, Lee, and Warm Springs RDs. Areas with potentially damaging densities of gypsy moth were identified on the Glenwood-Pedlar, Lee, and Warm Springs RDs. High densities of gypsy moth were found at the McFalls Creek, Jennings Creek, Harkening Hill, Little Mountain, Cove Mountain, Hawk, Mountain View, Squirrel Gap, and Kelly Run sites. In general, these sites had very high densities of large egg masses, indicative of healthy populations. The Hawk area was treated in 1993 (Btk), 1994 (diflubenzuron) and 2001(diflubenzuron); the Mountain View area was treated in 1993 (diflubenzuron) and 2001(diflubenzuron); and the Squirrel Gap area was treated in 1992, 1993, 1994 (Btk) and 2001(diflubenzuron).

The aerial treatments conducted in these areas in 2001, were successful in reducing the risk of defoliation. Egg mass surveys further confirmed a reduction in egg mass densities. Two areas, Story Book Trail and the Trout Pond Campground where egg mass densities indicate the risk of severe defoliation in 2002 are recommended for re-treatment (Table 1).

FHP estimates that 322,605 acres of the GWJNF were severely defoliated in 2001, and included 63,664 acres on the Glenwood-Pedlar, 44,997 on the James River, 77,606 on the Lee, 131,503 on the Warm Springs Ranger Districts (Figure 2).

Egg mass surveys conducted during August and September identified potentially damaging populations of gypsy moth on the Glenwood-Pedlar, James River, Lee, and Warm Springs (Table 1). The lengths of gypsy moth egg masses indicated that some populations were healthy and vigorous; however, in some areas smaller egg masses indicated populations were in decline. Gypsy moth populations on the Deerfield and Dry River remained very low in 2001.

Recommendations

Forest Health Protection recommends that the GWJNF consider treatment to reduce gypsy moth populations in the following recreation areas: Story Book Trail, Massanutten Visitor's Center, Elizabeth Furnace, Trout Pond, and Bolar Mountain area at Lake Moomaw. (1,145 acres, total). Also, the following high value timber areas should be considered for treatment to reduce defoliation and minimize damage of actively managed timber resources: Fore Mountain, Chestnut Mountain, and Wildcat Mountain (3,744 acres, total). Treatment is recommended on a total of 4,889 acres in FY 2002 to limit defoliation and damage.

Treatment Options

1 **No treatment**: In developed recreation areas, individual trees may be defoliated and further stressed above levels that normally result from visitor use without treatment of gypsy moth populations. Mortality of some trees is not expected until populations build to severely defoliating levels. Visitors may find the presence of large number of caterpillars and their excrement offensive and shorten their stay at the recreation areas or decide not to return in the future. Visitors may be at an increased risk of transporting life stages of the gypsy moth to uninfested areas or to their homes. Gypsy moth population buildup in the general forest area will cause moderate mortality in highly infested areas that were defoliated in 2001. Visitors may decide not to remain in dispersed camping areas in the general forest area due to the nuisance of gypsy moth caterpillars, their excrement, and the loss of shade.

2 **Treat only recreation areas using Bacillus thuringiensis var. kurstaki (Btk)**: All identified recreation areas with egg mass densities approaching or exceeding 250 per acre

would be treated with Btk, a biological insecticide registered for use against gypsy moth. None of the general forest areas would be treated, however they would be monitored. Gypsy moth population buildup in the general forest area will cause some damage in highly infested areas. Visitors may decide not to remain in dispersed camping areas in the general forest area due to the nuisance of gypsy moths and the loss of shade.

Btk contains spores and insecticidal crystal proteins produced by the soil-inhabiting bacterium, Bacillus thuringiensis var. kurstaki. The insecticide is toxic to gypsy moth and to other caterpillars in the insect order Lepidoptera (moths and butterflies). The insecticide is not considered toxic to humans, wildlife, fish or other biota.

3. **Treat the recreation areas and general forest areas using Btk:** All of the identified recreation areas with egg mass densities approaching 250 per acre and all the general forest areas with egg mass densities approaching 1,000 per acre would be treated with Btk. High populations (more than 1,000 egg masses per acre) in these areas may not be sufficiently reduced to prevent population buildup and defoliation.

4. **Treat recreation areas with Btk and general forest areas with diflubenzuron:** Identified recreation areas would be treated with Btk and general forest areas would be treated with diflubenzuron, except over open water or running water without a forest canopy. Btk would be applied near these sensitive open water areas. The use of diflubenzuron would reduce populations of gypsy moth more effectively when egg mass densities exceed 1,000 per acre.

   Diflubenzuron is particularly useful for managing high density populations (> 1,500 egg masses per acre), like those found at the Massanutten Visitor's Center and in the high-value timber areas. Only a single application would be required.

   Diflubenzuron's limitations are associated with its impact on other arthropods, including other foliage feeding insects, soil-inhabiting arthropods, and aquatic arthropods and crustaceans. Diflubenzuron persists on treated deciduous foliage throughout the summer and then enters the soil and aquatic ecosystems when leaves drop in the fall.

5. **Treat recreation areas and general forest areas with diflubenzuron:** All identified areas would be treated with diflubenzuron, except over open or running water without a forest canopy. In areas directly adjacent to open running water, a buffer zone would be established and Btk would be used (Btk would not be sprayed directly over standing water). High populations of gypsy moth (more than 1,000 egg masses per acre) in some recreation areas may be controlled more effectively using diflubenzuron rather than Btk.

6. **Integrated Pest Management:** Under the integrated pest management (IPM) approach, gypsy moth management utilizes monitoring and survey activities to determine where populations are established, estimate population density and quality, and predict how these populations are likely to change the following year. IPM utilizes surveys of population density and quality, economic consideration of the resources threatened and the cost of treatment, and evaluates the option of relying on natural control processes to reduce

populations to low levels without intervention. Treatments are recommended on the appropriateness of a tactic for each situation. Currently, biological and chemical insecticides are considered the only viable tactics for reducing high populations of gypsy moth. A combination of diflubenzuron, Btk, and Gypchek is proposed under the IPM approach because all of these insecticides are safe for humans and the environment and all are effective in reducing gypsy moth populations. As proposed, diflubenzuron or Btk would be used in recreation areas and general forest areas based on population density and quality and Btk would be used adjacent to open water and perennial streams without a forest canopy. Gypchek would be used in sensitive areas where impacts to non-target arthropods are not acceptable. Effects of this option would be similar to those described in the alternatives above.

Table 1. Gypsy Moth Egg Mass Survey Data Post- and Pre-Treatment for the George Washington National Forest and the Glenwood Ranger District of the Jefferson National Forest, FY 2002.

Lee Ranger District

Site:	Management Area:	Survey Type:	Acres:	EM Survey Results:	Egg Mass Length:
Hawk	**Recreation**	**Post-treatment**	**632**	**0**	
Squirrel Gap	**Timber Area**	**Post-treatment**	**124**	**0**	
Wolf Gap	**Recreation**	**Post-treatment**	**71**	**0**	
Trout Pond	**Recreation**	**Post-treatment**	**429**	**40-880 em/ac**	**25mm**
Mountain View	**Timber Area**	**Post-treatment**	**244**	**0**	
Cove Mountain	**Timber Area**	**Post-treatment**	**653**	**0**	
Story Book Trail	**Recreation**	**Post-treatment**	**61**	**>1000 em/ac**	**30mm**
Camp Roosevelt	**Recreation**	**Pre-treatment**		**<400 em/ac fungus/virus**	
Elizabeth Furnace	**Recreation**	**Pre-treatment**		**>1000 em/ac)**	**20mm**
Lion's Tale	**Recreation**	**Pre-treatment**		**<160 em/ac fungus/virus**	
Little Fort	**Recreation**	**Pre-treatment**		**<280 em/ac fungus/virus**	
Powell's Fort	**Recreation**	**Pre-treatment**		**<200 em/ac fungus/virus**	

Tomahawk Pond	**Recreation**	**Pre-treatment**		**0**	
Massanutten Visitor's Center	**Recreation**	**Pre-treatment**		**>1000 em/ac**	**35mm**

Deerfield Ranger District:

Site:	Management Area:	Survey Type:	Acres:	EM Survey Results:	Egg Mass Length:
Deerfield Work Center	**Developed**	**Pre-treatment**		**0**	
Braley Pond	**Recreation**	**Pre-treatment**		**0**	
Mountain House	**Recreation**	**Pre-treatment**		**0**	
Confederate Breast Works	**Recreation**	**Pre-treatment**		**0**	
Shaw's Fork Horse Camp	**Recreation**	**Pre-treatment**		**0**	
Augusta Springs	**Developed**	**Pre-treatment**		**0**	
Liptrap	**Timber Area**	**Pre-treatment**		**0**	
Fleming Branch	**Timber Sale**	**Pre-treatment**		**0**	
Powder House	**Timber Area**	**Pre-treatment**		**0**	
Rock Lick	**Timber Area**	**Pre-treatment**		**0**	
Toliver Hollow	**Timber Area**	**Pre-treatment**		**0**	
Sugartree	**Timber Area**	**Pre-treatment**		**0**	

James River Ranger District:

Site:	Management Area:	Survey Type:	Acres:	EM Survey Results:	Egg Mass Length:
Little Mountain	**General Forest**	**Post-treatment**	**628**	**0**	
Lake Moomaw	**Coles Point, Fortney, Morris Hill**	**Pre-treatment**		**0**	
Longdale Furnace	**Recreation**	**Pre-treatment**		**0**	

CliftonForge Reservoir	Recreation	Pre-treatment		0	
Hoover Creek	Timber Area	Pre-treatment		0	
Johnson Mountain	Timber Area	Pre-treatment		0	
Millennium	Timber Area #2	Pre-treatment		>5000 em/ac	25mm

Glenwood-Pedlar Ranger District:

Site:	Management Area:	Survey Type:	Acres:	EM Survey Results:	Egg Mass Length:
Cave Mountain Lake	Recreation	Post-treatment	254	<160 em/ac	
Jennings Creek	Timber Area	Post-treatment	148	0	
McFalls Creek	Timber Area	Post-treatment	241	0	
Sherando Lake	Recreation	Pre-treatment		0	
Hopper Creek	Recreation	Pre-treatment		0	
Crabtree Falls	Recreation	Pre-treatment		0	
Crabtree Meadows	Recreation	Pre-treatment		0	
Middle Creek	Timber Area	Pre-treatment	247	>3500 em/ac	20-25mm
Chestnut Mountain	Timber Area	Pre-treatment	224	0	
Icy Rock	Timber Area	Pre-treatment	216	>4000 em/ac	20-25mm
Yellowstone	Timber Area	Pre-treatment	484	0	
Welsh Hollow	Timber Area	Pre-treatment	353	0	

Warm Springs Ranger District:

Site:	Management Area:	Survey Type:	Acres:	EM Survey Results:	Egg Mass Length:
Kelly Run	**Timber Area**	**Post-treatment**	**832**	**0**	
Hidden Valley	**Recreation**	**Post-treatment**	**21**	**0**	
Blowing Springs	**Recreation**	**Pre-treatment**		**0**	
Lake Moomaw-Bolar Mt.	**Recreation Camp2 & 3**	**Pre-treatment**		**>1000 em/ac**	**20-25mm**
Bubbling Springs	**Recreation**	**Pre-treatment**		**0**	
Poor Farm Area	**Recreation**	**Pre-treatment**		**0**	
Robinson Lane	**Timber Area**	**Pre-treatment**		**0**	
Dry Run	**Timber Area**	**Pre-treatment**		**0**	

Figure 1. Gypsy Moth Defoliation on the George Washington and Jefferson National Forests, Fiscal Year 2000.

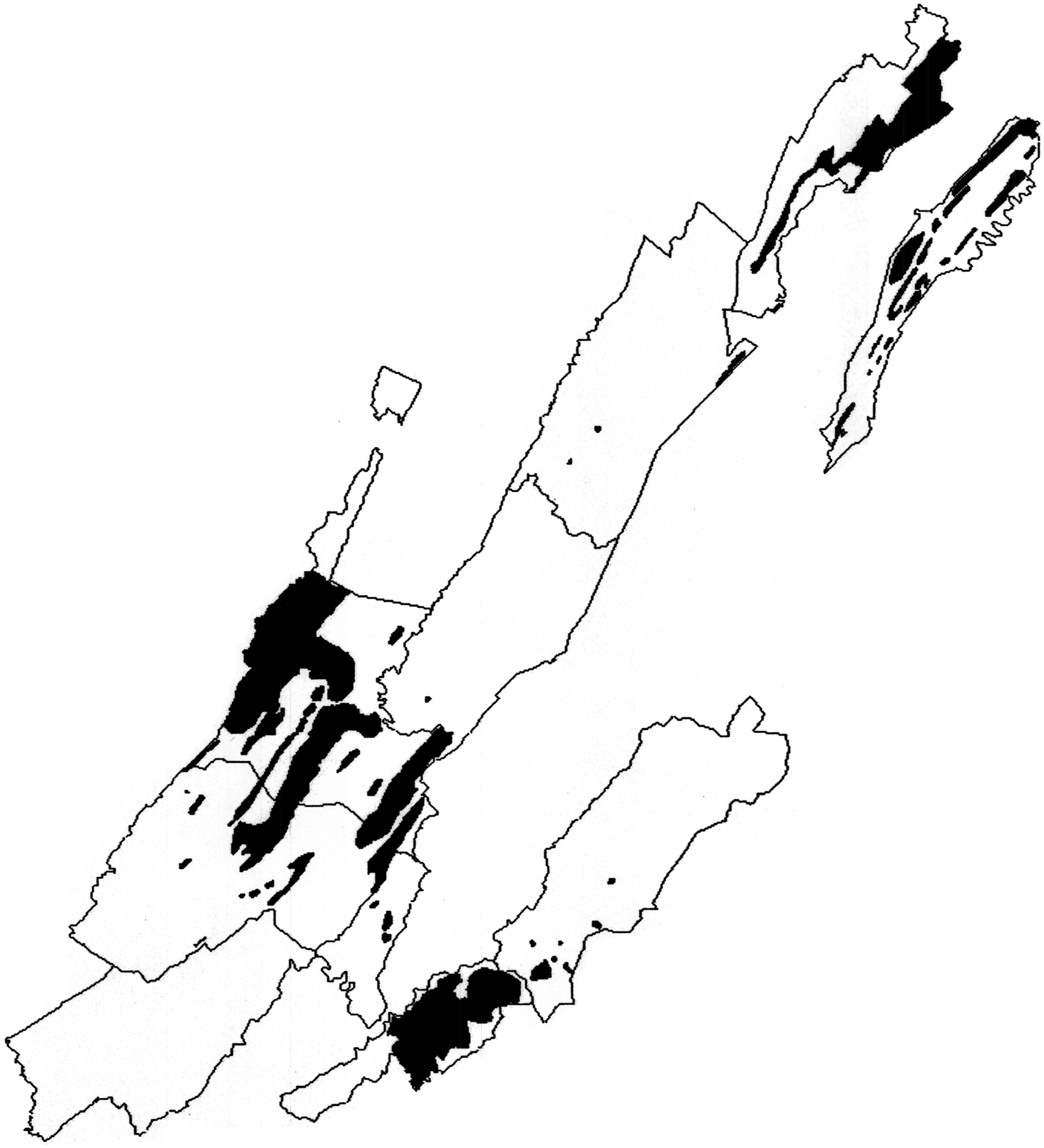


Figure 2. Gypsy Moth Defoliation on the George Washington and Jefferson National Forests, Fiscal Year 2001.

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